



Understanding How They Attack Your Weaknesses: CAPEC



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May 2011



maintaining the data needed, and c including suggestions for reducing	lection of information is estimated to ompleting and reviewing the collect this burden, to Washington Headqu uld be aware that notwithstanding an DMB control number.	ion of information. Send comments arters Services, Directorate for Infor	regarding this burden estimate mation Operations and Reports	or any other aspect of the property of the contract of the con	nis collection of information, Highway, Suite 1204, Arlington	
1. REPORT DATE MAY 2011	2. REPORT TYPE			3. DATES COVERED 00-00-2011 to 00-00-2011		
4. TITLE AND SUBTITLE				5a. CONTRACT NUMBER		
Understanding How They Attack Your Weaknesses: CAPEC				5b. GRANT NUMBER		
				5c. PROGRAM ELEMENT NUMBER		
6. AUTHOR(S)				5d. PROJECT NUMBER		
				5e. TASK NUMBER		
				5f. WORK UNIT NUMBER		
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) The MITRE Corporation,202 Burlington Road,Bedford,MA,01730-1420				8. PERFORMING ORGANIZATION REPORT NUMBER		
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)		
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)		
12. DISTRIBUTION/AVAIL Approved for publ	LABILITY STATEMENT ic release; distributi	on unlimited				
	otes Brd Systems and Softed in part by the US.			•	⁷ 2011, Salt Lake	
14. ABSTRACT						
15. SUBJECT TERMS						
16. SECURITY CLASSIFICATION OF: 17. LII				18. NUMBER	19a. NAME OF	
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified	Same as Report (SAR)	OF PAGES 21	RESPONSIBLE PERSON	

Report Documentation Page

Form Approved OMB No. 0704-0188



Agenda

8:00-8:45am Software Security Knowledge

about Applications Weaknesses

9:00-9:45am Software Security Knowledge

about Attack Patterns Against

Applications

Training in Software Security

10:15-11:00am Software Security Practice

11:15-12:00am Supporting Capabilities

Assurance Cases

Secure Development & Secure

Operations





The Long-established Principal of "Know Your Enemy"

"One who knows the enemy and knows himself will not be endangered in a hundred engagements. One who does not know the enemy but knows himself will sometimes be victorious. Sometimes meet with defeat. One who knows neither the enemy nor himself will invariably be defeated in every engagement."



■ The Art of War, Sun Tzu





The Importance of Knowing Your Enemy

An appropriate defense can only be established if you know how it will be attacked

Remember!

- Software Assurance must assume motivated attackers and not simply passive quality issues
- Attackers are very creative and have powerful tools at their disposal
- Exploring the attacker's perspective helps to identify and qualify the risk profile of the software





What are Attack Patterns?

- Blueprint for creating a specific type of attack
- Abstracted common attack approaches from the set of known exploits
- Capture the attacker's perspective to aid software developers, acquirers and operators in improving the assurance profile of their software





Leveraging Attack Patterns Throughout the Software Lifecycle

- Guide definition of appropriate policies
- Guide creation of appropriate security requirements (positive and negative)
- Provide context for architectural risk analysis
- Guide risk-driven secure code review
- Provide context for appropriate security testing
- Provide a bridge between secure development and secure operations



Common Attack Pattern Enumeration and Classification (CAPEC)



Community effort targeted at:

- Standardizing the capture and description of attack patterns
- Collecting known attack patterns into an integrated enumeration that can be consistently and effectively leveraged by the community
- Gives you an attacker's perspective you may not have on your own

Excellent resource for many key activities

- Abuse Case development
- Architecture attack resistance analysis
- Risk-based security/Red team penetration testing
- Whitebox and Blackbox testing correlation
- Operational observation and correlation

Where is CAPEC today?

- http://capec.mitre.org
- Currently 386 patterns, stubs, named attacks









What do Attack Patterns Look Like?



Primary Schema Elements

- Identifying Information
 - Attack Pattern ID
 - Attack Pattern Name
- Describing Information
 - Description
 - Related Weaknesses
 - Related Vulnerabilities
 - Method of Attack
 - Examples-Instances
 - References
- Prescribing Information
 - Solutions and Mitigations
- Scoping and Delimiting Information
 - Typical Severity
 - Typical Likelihood of Exploit
 - Attack Prerequisites
 - Attacker Skill or Knowledge Required
 - Resources Required
 - Attack Motivation-Consequences
 - Context Description

Supporting Schema Elements

- Describing Information
 - Injection Vector
 - Payload
 - Activation Zone
 - Payload Activation Impact

Diagnosing Information

- Probing Techniques
- Indicators-Warnings of Attack
- Obfuscation Techniques

Enhancing Information

- Related Attack Patterns
- Relevant Security Requirements
- Relevant Design Patterns
- Relevant Security Patterns



Attack Pattern Description Schema Formalization

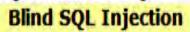


Description

- Summary
- Attack Execution Flow
 - Attack_Phase^{1..3} (Name(Explore, Experiment, Exploit))
 - Attack_Step^{1..*}
 - Attack_Step_Title
 - Attack_Step_Description
 - Attack_Step_Technique 0..*
 - Attack_Step_Technique_Description
 - Leveraged_Attack_Patterns
 - Relevant_Attack_Surface_Elements
 - Observables^{0..*}
 - Environments
 - Indicator^{0..*} (ID, Type(Positive, Failure, Inconclusive))
 - Indicator_Description
 - Relevant_Attack_Surface_Elements
 - Environments
 - Outcome^{0..*} (ID, Type(Success, Failure, Inconclusive))
 - Outcome_Description
 - Relevant_Attack_Surface_Elements
 - Observables^{0..*}
 - Environments
 - Security Control^{0..*} (ID, Type(Detective, Corrective, Preventative))
 - Security_Control_Description
 - Relevant_Attack_Surface_Elements
 - Observables^{0..*}



Individual CAPEC Dictionary Definition (Release 1.2)



Pattern Abstraction: Detailed

Attack Pattern 7

ID

Typical Severity High

Description

Summary

Blind SQL Injection results from an insufficient mitigation for SQL Injection. Although suppressing database error messages are considered best practice, the suppression alone is not sufficient to prevent SQL Injection. Blind SQL Injection is a form of SQL Injection that overcomes the lack of error messages. Without the error messages that facilitate SQL Injection, the attacker constructs input strings that probe the target through simple Boolean SQL expressions. The attacker can determine if the syntax and structure of the injection was successful based on whether the query was executed or not. Applied iteratively, the attacker determines how and where the target is vulnerable to SQL Injection.

In order to achieve this using Blind SQL Injection, an attacker:

For example, an attacker may try entering something like "username' AND 1=1; --" in an input field. If the result is the same as when the attacker entered "username" in the field, then the attacker knows that the application is vulnerable to SQL Injection. The attacker can then ask yes/no questions from the database server to extract information from it. For example, the attacker can extract table names from a database using the following types of queries:

"username' AND ascii(lower(substring((SELECT TOP 1 name FROM sysobjects WHERE xtype='U'), 1, 1))) > 108".

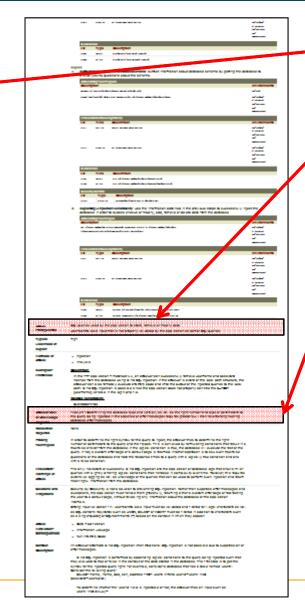
If the above query executes properly, then the attacker knows that the first character in a table name in the database is a letter between m and z. If it doesn't, then the attacker knows that the character must be between a and I (assuming of course that table names only contain alphabetic characters). By performing a binary search on all character positions, the attacker can determine all table names in the database. Subsequently, the attacker may execute an actual attack and send something like:

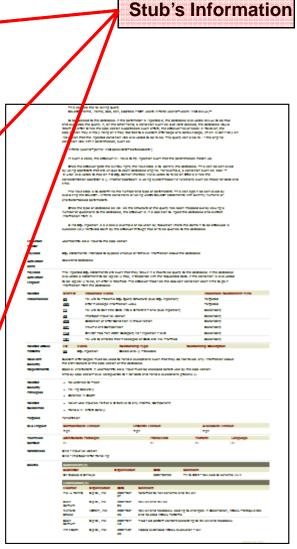
"username"; DROP TABLE trades; --

Complete CAPEC Entry Information







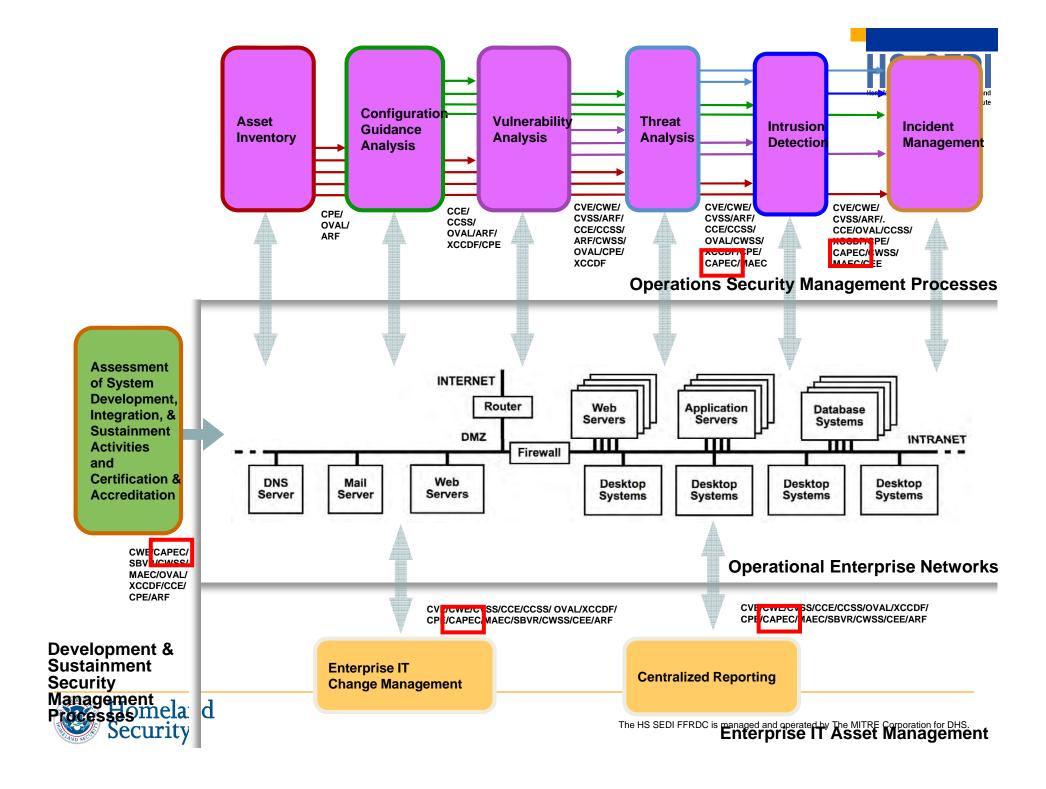




A Few Key Use Cases for CAPEC in Support of SwA

- Help developers understand weaknesses in their real-world context (how they will be attacked)
- Objectively identify specific attacks under which software must demonstrate resistance, tolerance and resilience for a given level of assurance
- Indirectly scope which weaknesses are relevant for a given threat environment
- Identify relevant mitigations that should be applied as part of policy, requirements, A&D, implementation, test, deployment and operations
- Identify and characterize patterns of attacks for security test case generation
- Identify and characterize threat TTPs for red teaming
- Identify relevant issues for automated tool selection
- Identify and characterize issues for automated tool results analysis





CAPEC Status



Where is CAPEC today?

•V1.4

- Massive schema changes
 - Including addition of Observables structure
- Some new content
- Added initial set of network attack patterns

•V1.5

- Added ~25 new network attack patterns
- •Added enhanced material to ~35 patterns
- New View added for WASC Threat Taxonomy 2.0
- •Added ~65 mappings to CWE and several within CAPEC

•V1.6

- •Added 7 new application framework attack patterns as well as 68 new attack patterns in three new attack pattern categories: Physical Security Attacks, Social Engineering Attacks & Supply Chain Attacks
- Added ~35 mappings to CWE and several within CAPEC

Currently 386 patterns, stubs, named attacks; 68 categories and 6 views



CAPEC Current Content (15 Major Categories)



1000 - Mechanism of Attack

- Data Leakage Attacks (118)
- •Resource Depletion (119)
- •Injection (Injecting Control Plane content through the Data Plane) (152)
- **•**Spoofing (156)
- •Time and State Attacks (172)
- Abuse of Functionality (210)
- Exploitation of Authentication (225)
- Probabilistic Techniques (223)
- Exploitation of Privilege/Trust (232)
- Data Structure Attacks (255)
- Resource Manipulation (262)
- Physical Security Attacks (436)
- •Network Reconnaissance (286)
- Social Engineering Attacks (403)
- Supply Chain Attacks (437)



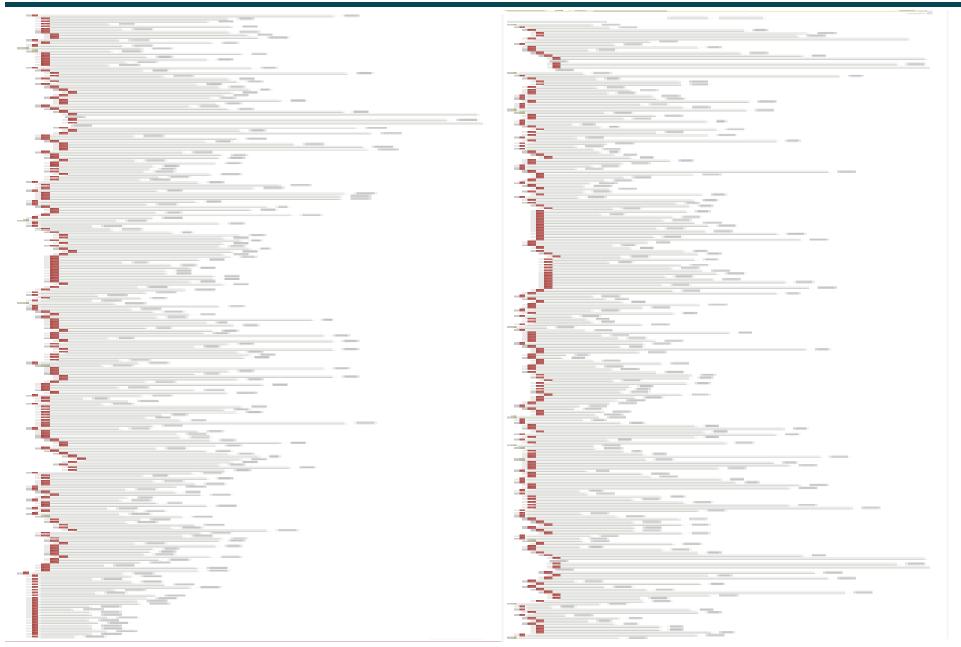
CAPEC Current Content (Which Expand to...)



```
Exploitation of Authentication - (225)
1000 - Mechanism of Attack
          Data Leakage Attacks - (118)
                                                                                                        Exploitation of Session Variables, Resource IDs and other Trusted
                     Data Excavation Attacks - (116)
                                                                                                        Credentials - (21)
                     Data Interception Attacks - (117)
                                                                                                        Authentication Abuse - (114)
          Resource Depletion - (119)
                                                                                                        Authentication Bypass - (115)
                     Violating Implicit Assumptions Regarding XML Content (aka XML Denial Exploitation of Privilege/Trust - (232)
                     of Service (XDoS)) - (82)
                                                                                                        Privilege Escalation - (233)
                                                                                                        Exploiting Trust in Client (aka Make the Client Invisible) - (22)
                     Resource Depletion through Flooding - (125)
                     Resource Depletion through Allocation - (130)
                                                                                                        Hijacking a Privileged Thread of Execution - (30)
                     Resource Depletion through Leak - (131)
                                                                                                        Subvert Code-signing Facilities - (68)
                     Denial of Service through Resource Depletion - (227)
                                                                                                        Target Programs with Elevated Privileges - (69)
          Injection (Injecting Control Plane content through the Data Plane) - (152)
                                                                                                        Exploitation of Authorization - (122)
                     Remote Code Inclusion - (253)
                                                                                                        Hijacking a privileged process - (234)
                     Analog In-band Switching Signals (aka Blue Boxing) - (5)
                                                                                             Data Structure Attacks - (255)
                     SQL Injection - (66)
                                                                                                        Accessing/Intercepting/Modifying HTTP Cookies - (31)
                     Email Injection - (134)
                                                                                                        Buffer Attacks - (123)
                     Format String Injection - (135)
                                                                                                        Attack through Shared Data - (124)
                     LDAP Injection - (136)
                                                                                                        Integer Attacks - (128)
                     Parameter Injection - (137)
                                                                                                        Pointer Attack - (129)
                     Reflection Injection - (138)
                                                                                             Resource Manipulation - (262)
                     Code Inclusion - (175)
                                                                                                        Accessing/Intercepting/Modifying HTTP Cookies - (31)
                     Resource Injection - (240)
                                                                                                        Input Data Manipulation - (153)
                     Script Injection - (242)
                                                                                                        Resource Location Attacks - (154)
                     Command Injection - (248)
                                                                                                        Infrastructure Manipulation - (161)
                     Character Injection - (249)
                                                                                                        File Manipulation - (165)
                     XML Injection - (250)
                                                                                                        Variable Manipulation - (171)
                     DTD Injection in a SOAP Message - (254)
                                                                                                        Configuration/Environment manipulation - (176)
          Spoofing - (156)
                                                                                                        Abuse of transaction data strutcture - (257)
                     Content Spoofing - (148)
                                                                                                        Registry Manipulation - (269)
                     Identity Spoofing (Impersonation) - (151)
                                                                                                        Schema Poisoning - (271)
                                                                                                        Protocol Manipulation - (272)
                     Action Spoofing - (173)
          Time and State Attacks - (172)
                                                                                             Network Reconnaissance - (286)
                     Forced Deadlock - (25)
                                                                                                        ICMP Echo Request Ping - (285)
                     Leveraging Race Conditions - (26)
                                                                                                        TCP SYN Scan - (287)
                     Leveraging Time-of-Check and Time-of-Use (TOCTOU) Race Conditions -
                                                                                                        ICMP Echo Request Ping - (288)
                                                                                                        Infrastructure-based footprinting - (289)
                     Manipulating User State - (74)
                                                                                                        Enumerate Mail Exchange (MX) Records - (290)
          Abuse of Functionality - (210)
                                                                                                        DNS Zone Transfers - (291)
                     Functionality Misuse - (212)
                                                                                                        Host Discovery - (292)
                     Abuse of Communication Channels - (216)
                                                                                                        Traceroute Route Enumeration - (293)
                     Forceful Browsing - (87)
                                                                                                        ICMP Address Mask Request - (294)
                     Passing Local Filenames to Functions That Expect a URL - (48)
                                                                                                        ICMP Timestamp Request - (295)
                     Probing an Application Through Targeting its Error Reporting - (54)
                                                                                                        ICMP Information Request - (296)
                     WSDL Scanning - (95)
                                                                                                        TCP ACK Ping - (297)
                     API Abuse/Misuse - (113)
                                                                                                        UDP Ping - (298)
                     Try All Common Application Switches and Options - (133)
                                                                                                        TCP SYN Ping - (299)
                     Cache Poisoning - (141)
                                                                                                        Port Scanning - (300)
                     Software Integrity Attacks - (184)
                                                                                                        TCP Connect Scan - (301)
                     Directory Traversal - (213)
                                                                                                        TCP FIN scan - (302)
                                                                                                        TCP Xmas Scan - (303)
                     Analytic Attacks - (281)
          Probabilistic Techniques - (223)
                                                                                                        TCP Null Scan - (304)
                                                                                                        TCP ACK Scan - (305)
                     Fuzzing - (28)
  Homelar Mahipulating Opaque Client-based Data Tokens - (39)
                                                                                                        TCP Window Scan - (306)
                                                                                                        TCP RPC Scan - (307)
UDP Scan - (368) S SEDI FFRDC is managed and operated by The MITRE Corporation for DHS.
   ecurity Screen Temporary Files for Sensitive Information - (155)
```

CAPEC Current Content (386 Attacks...)





Current Maturation Paths



- Extend coverage of CAPEC
- Improve quality of CAPEC
- Expand the scope of CAPEC
- Bridge secure development with secure operations
- Improve integration with other standards (MAEC, CEE, etc.)
- Expand use of CAPEC



CAPEC Future Plans



- •V1.7 (within the next month or two)
 - •Will flesh out ~30-40 stub patterns to full patterns
 - •Will include existing content that has been refined for quality & consistency
 - •Will incorporate initial use of the Observables sub-schema
- •Strategic focus for the near to mid-term will be on utilizing CAPEC as a bridge between secure development and secure operations
- Continue expanding and refining content
- Continue expanding outreach and supporting CAPEC use
- Establish initial compatibility program



Questions?

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